



## Nothing at Last - Indian Mathematics

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When you do your algebra, you use Arabic numbers instead of hieroglyphics or Roman numerals. Arabic numbers were invented in India, but no one knows their exact origin. Indians loved astronomy, like the Greeks, and Indians had rope stretchers, like the Egyptians. Babylonian mathematics also influenced Indian mathematicians. However, in 500 AD, the Indians came up with something completely original: Arabic numbers. No one knows exactly who designed the symbols, but one legend said that a glassblower created the shapes of the Arabic numerals.

The Arabic system used a base of ten and was more efficient than any prior mathematical system for several reasons. Each number had a separate symbol and name. Combinations of these ten symbols and names created larger numbers. Arabic numbers could go on forever, rather than stopping at 900 like the Greek system, or at 1,000 like the Roman system. Each number stood on its own, unlike the Roman system that combined more than one symbol to form larger numbers. The Indians could add, subtract, divide, and multiply numbers without the Roman abacus. Sometimes there were contests between mathematicians who used the abacus and ones who used the Arabic numbers. Those who used Arabic numbers won easily!

One of the greatest advantages of the Arabic numeral system is that at last there was a symbol for nothing. Ancient peoples did not need a zero because they used numbers for counting small quantities, but a zero was necessary as a placeholder in more complex calculations. The word zero comes from an Arabic word, *sifr*, which means "empty." When western scholars described the new number to their colleagues, they turned *sifr* into the Latin-sounding word *zephyrus*. This word became "zero." Zero replaced the blank space that early number systems used for "nothing."

In addition to the invention of zero, the Arabic number system made another important development in mathematics possible. The Indians understood the interplay of numbers in a new way and recognized the existence of negative numbers for the first time. This recognition led to a new way of doing math that was the beginning of modern-day algebra. The word algebra comes from the Arabic *al-jabr*, a word that described a way of solving equations.

Indian mathematicians solved problems that had confused earlier scholars. One mathematician named Varahamihira learned how to forecast the positions of planets. He wrote a famous treatise called *The Five Astronomical Canons* in 575 AD on the motion of heavenly bodies, meteors, and the sun. The observations of Greek astronomers in the 1st century AD formed the basis of his work. He also figured out certain trigonometric formulae, such as relationships between sine and cosine. Accuracy was important because Indians used his trigonometric tables to figure out astrology, a respected science in ancient India. Varahamihira was one of the most famous astrologers in Indian history. He also fine-tuned the calendar based upon his discoveries.

Aryabhata was another famous mathematician of the 6th century. One of his major contributions was to compile a summation of Hindu mathematics up to that time. His work contained sixty-six mathematical rules, as well as observations of the planets, and geometric observations about spheres and ellipses. He also wrote about quadratic equations, trigonometry, and he calculated the most accurate value for  $\pi$  in the ancient world. His value for  $\pi$  was 3.1416. Our value today is 3.14159265. Other Indian mathematicians over the next several centuries made significant progress in astronomy, trigonometry, and complex equations.

Since many Indian mathematicians made so many advances with the new numbers, perhaps these numbers should have been called Indian numbers. However, they were named "Arabic" because Arabic scholars and traders learned about them in India and brought them to the west. The traders followed ancient caravan routes that passed through Persia, Mesopotamia, and Baghdad. Baghdad became the greatest center of learning at that time. Eastern mathematicians brought the new numbers and the arithmetic of India to Baghdad, while western scholars brought treatises on astronomy and geometry from Greece. Muslim mathematicians in Baghdad used all of this knowledge to make significant advances in mathematics and in the creation of nautical almanacs and instruments so mariners could easily navigate by the sun and the stars. The new number system made much of this progress possible. The number system spread from Baghdad to Europe by 1200 AD because of a translation of an Arabic

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book on mathematics.

Despite the brilliant simplicity of the Arabic number system, it was slow to catch on in Europe. Most people were not able to read and write, so they could not use the new numbers. Mathematicians who used the Roman numbers were highly respected, and they were afraid of losing social status if Europe accepted the new system. An Italian decree issued in 1299 AD made the new numbers illegal! In spite of such reactions, Arabic numbers were finally adopted in the 17th century, and the mathematical world breathed a sigh of relief.

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## Questions

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- \_\_\_\_\_ 1. Check which other mathematical systems influenced Indian mathematics.
  - A. Egyptian
  - B. Greek
  - C. European
  - D. Babylonian
- \_\_\_\_\_ 2. When was the Arabic number system created?
  - A. 500 BC
  - B. 500 AD
  - C. 50 AD
  - D. 50 BC
- \_\_\_\_\_ 3. What was completely new in the Arabic number system?
  - A. It had simpler symbols.
  - B. It had a zero.
  - C. It had a base of 10.
  - D. It was used to calculate geometric values.
- \_\_\_\_\_ 4. Which language did the word zero originally come from?
  - A. Arabic
  - B. Egyptian
  - C. Italian
  - D. Greek
- \_\_\_\_\_ 5. Which mathematician developed the most accurate value for  $\pi$ ?
  - A. Aryabhata
  - B. Pythagoras
  - C. Varahamihira
  - D. Archimedes
- \_\_\_\_\_ 6. What new kind of math was developed by the Indian mathematicians?
  - A. astronomy
  - B. geometry
  - C. calculus
  - D. algebra

\_\_\_\_\_ 7. What city transmitted the Arabic numbers to Europe?

- A. Florence  
B. Baghdad  
C. Constantinople  
D. Rome

\_\_\_\_\_ 8. Why did it take Europeans a long time to adopt the Arabic number system? Check all that apply.

- A. Some mathematicians feared a loss of status if the new numbers were used.  
B. Some people did not like the way the numbers looked.  
C. People could not read and write and therefore did not use the new numbers.  
D. Europeans preferred their own number system.

**Write a paragraph about why it is important to have a zero and what problems might arise without it.**

[illegible]